COMBUSTION

Project Fact Sheet

Dilute Oxygen Combustion System

Benefits

- Potential productivity increase of 10%-30% over air-fuel combustion
- Fuel savings of up to 50% over air-fuel combustion
- NOx emissions less than 0.015 lb/MMBtu, equivalent to 10 ppm from air-fuel combustion
- Improved heating uniformity giving better quality, fewer rejects in rolled product
- Simple, low-maintenance combustion system

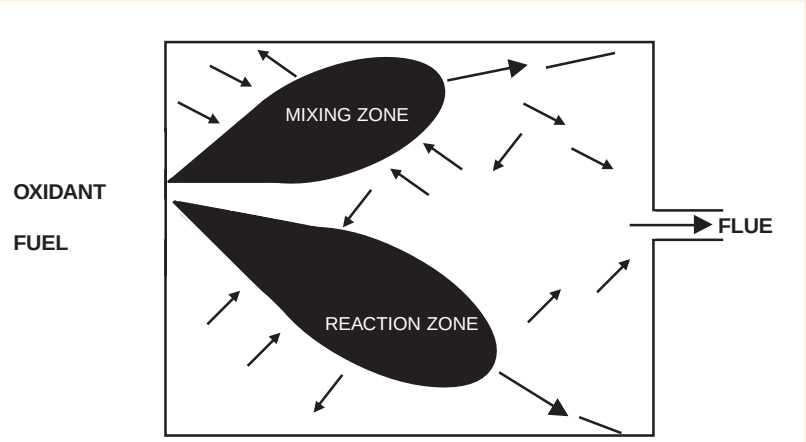
Applications

The Dilute Oxygen Combustion (DOC) system can be added to continuous reheat furnaces, used for over 90% of steel reheating, either as a replacement for an existing heating zone or as a new on-demand booster zone. Because the DOC system gives low NOx levels in high-nitrogen environments, it is especially well suited for partial furnace conversions where soak zones remain on conventional air-fuel burners. The low capital, low emissions, high productivity features are available for all segments of the steel industry.

Dilute oxygen combustion improves reheat furnace performance and provides very low NOx emissions

The Dilute Oxygen Combustion (DOC) system provides competitive rolling mill operators with higher productivity reheat furnaces without high capital and operating costs or increased NOx emissions. By replacing combustion air with oxygen, DOC needs less fuel to heat steel and also gives lower flue gas temperatures. These features allow a reheat furnace to econonmically operate at higher production rates. The DOC system injects the fuel gas and oxygen into the furnace as distinct, high velocity jets through separate lances, rather than through a single burner. The jets mix with the hot furnace gases before reacting with each other. This dilution effect prevents the high peak flame temperatures which are responsible for NOx generation, providing low NOx levels even with high nitrogen levels for the furnace. Because the flue gas is recirculated aerodynamically within the furnace, the DOC system is simple and inexpendisve to install compared with conventional flue gas recirculation systems. In addition, the wide, diffuse flame from the DOC system provides exceptionally uniform heating of the steel leading to better rolling mill performance and lower reject rates.

Dilute Oxygen Combustion



Schematic representation of Dilute Oxygen Combustion.

Project Description

Goal: To demonstrate the DOC system on a commercially-operating, continuous steel reheat furnace.

Dilute oxygen combustion relies on the rapid and complete mixing of fuel and oxygen jets with hot furnace gases contaiing low levels of oxygen. A fundamental understanding of mixing phenomena of jets with a hot, ractive environment is needed for the reliable design of a DOC system, but little data is available. A bench-scale laboratory apparatus has been used to develop basic data on mixing of reactive jets.

Laboratory furnace and pilot-scale furnaces have been used to measure NOx levels from prototype and commercial-scale DOC burners, and to investigate the effect of furnace-scale mixing on NOx generation. These results were used to verify a physical model which uses a laser-fluorescence technique. The physical model technique was also used to guide scale-up to full scale.

A full-scale DOC system has been installed on a commercial furnace. Furnace performance and emissions with DOC will be compared with the air-fuel system baseline.

Progress and Milestones

- Fundamental data on mixing and stability of DOC flames has been developed and published.
- Laboratory furnace data have been developed demonstrating NOx levels below 0.015 lb/MMBtu (equivalent to,10 ppm from an air-fuel system) at temperatures of 2350°F and nitrogen levels of 45%. Similar results were achieved with a full-scale burner at 7 MMBtu/hour firing rate.
- A commercial DOC system is being installed at Auburn Steel Company, Inc. in Auburn, NY. Two preheat DOC zones will provide 52 MMBtu/hour firing rate, roughly one-half of the furnace requirement. The commercial demonstration will begin in early 1999.

Project Partners

Praxair, Inc.
Tarrytown, NY

North American Manufacturing Company
Cleveland, OH

Auburn Steel Company, Inc.
Auburn, NY

Pittsburgh Industrial Furnace Company
Pittsburgh, PA

University of Michigan
Ann Arbor, MI

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